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2005

Online at <https://mpra.ub.uni-muenchen.de/63788/>
MPRA Paper No. 63788, posted 21 Apr 2015 18:56 UTC

The Exchange Rate Managements in Crisis- experienced Emerging Market Economies after the 1990s

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Abstract

This article examined the exchange rate managements in the crisis-experienced emerging market economies after the 1990s. First, we found that the exchange rate flexibility has increased from the pre-crisis period towards the post-crisis period under the “soft peg” regime. Second, we identified a structural change in the factors for determining a reference rate in exchange rate management from the pre-crisis period to the post-crisis period. Third, we found that East Asian countries, in their post-crisis exchange rate managements, might reduce US dollar dominance, while raising the other currencies’ weight, and further found that the countries who were not sensitive to inflation rates in their pre-crisis managements, might raise its sensitivity during the post-crisis period.

1. Introduction

Exchange rate management is one of the central issues of macroeconomic policies. Since the postwar period, there has been a long-term debate over the merits of fixed versus floating exchange rates. The debate, which is typically framed in terms of the trade-off between credibility and flexibility, has gone through several swings of the pendulum. Recently, the debate on exchange rate regimes has become focused on whether or not the intermediate regimes such as target zones, crawling and basket pegs are vanishing, in other words, whether or not exchange rate regimes are moving to a corner solution with the "hard peg" or the "free float". So far, no clear consensus has been reached.

The financial crises in Mexico (1994-95), East Asia (1997-98), Russia (1998), and Brazil (1999) have refocused attention on exchange rate managements of emerging market economies. Most views expressed criticize the pre-crisis US dollar peg regime as one of the causes of the crisis. It is said that this regime induced short-term external over-borrowing and caused the appreciation of real exchange rates with the loss of competitiveness. Then, the question arises as to whether, after the crisis, the countries are simply returning to the pre-crisis US dollar standard, or whether they have learned a lesson from the crisis and are finding another path to follow.

This article examines the exchange rate managements in the crisis-experienced emerging market economies after the 1990s. It focuses, as analytical sample countries, on the seven crisis-experienced countries among emerging market economies: Mexico, Thailand, the Philippines, Indonesia, Korea, Russia and Brazil. Specifically, the two main questions are these: whether the flexibility in their managed exchange rates has increased from the pre-crisis period (of the dollar peg system) towards the post-crisis period, and if so what factors have made the exchange rate managements more flexible in the post-crisis period. Our hypothesis is that the crisis-experienced countries, learning a lesson from the Asian crisis, have raised the flexibility of exchange rate management in the post-crisis period, in such a way that they, not simply relying on the US dollar pegging, have cared more about such other factors as inflation rate and currency basket including Japanese yen and the euro as the benchmarks for the choice of reference rates in their exchange rate

management.

The rest of the paper is organized as follows: Section 2 reviews the recent debates on exchange rate regimes and clarifies this article's position among the debates. Section 3 conducts empirical studies of the exchange rate managements in the crisis-experienced sample countries after the 1990s. Section 4 presents concluding remarks.

2. Recent Debates on Exchange Rate Regimes and This Article's Position

This section reviews the recent debates on exchange rate regimes: the corner solution hypothesis versus the "Fear of Floating" hypothesis. Based on the review, it clarifies this article's position among the debates on exchange rate regimes.

2.1 Recent Debates on Exchange Rate Regimes

Since the postwar period, there has been a long-term debate over the merits of fixed versus floating exchange rates. The debate, which is typically framed in terms of the trade-off between credibility and flexibility, has gone through several swings of the pendulum. Recently, the debates on exchange rate regimes have become focused on whether or not the intermediate regimes such as target zones, crawling and basket pegs are vanishing, in other words, whether or not exchange rate regimes are moving to a corner solution with the "hard peg" or the "free float".

The corner solution hypothesis¹ has often been explained by the principle of the Impossible Trinity, that is, a country has to give up one of three goals: exchange rate stability, monetary independence, and financial market integration. Summers (1999) states that as capital market integration increases, countries would be forced increasingly to more pure floating or more purely fixed regimes. ADB (2001) explains, from the practical viewpoint, that large and liquid international capital markets make it more difficult for national authorities to support a shaky currency peg, since the resources of the markets far outstrip the reserves of even the best-armed central banks and governments.²

The "Fear of Floating" hypothesis is a counter-argument against the corner solution hypothesis. Calvo and Reinhart (2000) insists that a careful reading of the evidence on exchange rate policy presents a strikingly

different picture; countries that say they allow their exchange rate to float mostly do not – there seems to be an epidemic case of the “fear of floating”, particularly among emerging market economies. They present an analytical model that suggests that, even in the best of times, when countries retain voluntary access to international capital markets, lack of credibility will lead to the “fear of floating”. They also found, in their empirical analyses across 154 exchange rate arrangements, a low variability of exchange rates and a high volatility of central bank reserves that suggest significant central bank intervention.³

Williamson (2000) also questions the efficacy of the two-corner solution by stating that the currency boards have already been subjected to substantial speculative pressure both in Argentina and in Hong Kong, and that a country with a freely floating rate may suffer from excess volatility of the exchange rate. He argues that the behavior of most of the emerging market countries is motivated not by an irrational, short-run “fear of floating”, but by legitimate concerns that floating will generate long-run misalignments. Williamson then recommends the BBC rules (basket, band and crawl) for emerging market economies. Kawai (2002), recognizing that the corner solution approach does not seem to be realistic in many emerging East Asian economies because of the “fear of floating”, states that a reasonable exchange rate policy for the region would be to stabilize rates to a basket of currencies consisting of the US dollar, the yen and the euro, given emerging East Asia's diversified trade and FDI relationships with the United States, Japan, and the European Union and given the continued high exchange-rate volatility among the tri-polar currencies.⁴

2.2 This Article's Position in the Debates on Exchange Rate Regimes

Ito (2001) states that the debate over what would be desirable exchange rate regimes for Asian countries seems likely to continue, although the selection of an exchange rate regime will be crucial for Asian countries' further recovery and beyond. For the empirical analyses in the following section, we here clarify this article's position among the fore-mentioned recent debates on exchange rate regimes.

First, among the recent debates of Section 2.1, we follow the “Fear of Floating” hypothesis, considering that the corner solution approach

does not seem to be realistic in many emerging market economies; we presume that the sample countries have adopted "soft peg" regime in the pre- and post-crisis exchange rate managements, namely, intermediate regime placed between free floating and such a rigid fixed system as currency board. Section 3.3 will show that the sample countries are holding to the "soft peg" even in the post-crisis period regardless of their classification into the "free float", by examining the volatility of their foreign exchange reserves.

Second, we then concentrate on where are the benchmarks, the choice of appropriate reference rates in managed exchange rates. Our major concern is whether the flexibility in the managed exchange rates of the East Asian sample countries has increased from the pre-crisis period (of the dollar peg system) towards the post-crisis period. Under the framework of the intermediate exchange rate regime, the rising flexibility of exchange rate means that the benchmarks for the choice of reference rates in managed exchange rates may be diversified in the post-crisis period compared with the single benchmark of the US dollar in the pre-crisis period. Therefore, our specific concern on the flexibility of exchange rate is whether the sample countries, not simply relying on the US dollar, have cared more about such other factors as inflation rate and currency basket including the Japanese yen and the euro as the benchmarks for the choice of reference rates in their exchange rate managements during the post-crisis period. Section 3.3 will examine the change of exchange rate flexibility from the pre-crisis period to the post-crisis period, and Section 3.4 will identify the factors to make exchange rate managements more flexible in the post-crisis period by using the analytical framework of Frankel and Wei (1994) in the sample countries.

Third, the theoretical background of our hypothesis that the sample countries have raised the flexibility of their post-crisis managed exchange rates comes from the principle of the Impossible Trinity. As mentioned in Section 2.1, Summers (1999) explains that the principle of the Impossible Trinity leads exchange rate regime under capital market integration to the two-corner solution with the "hard peg" or the "free float". Frankel et al. (2000) makes a negative comment on this explanation by Summers (1999), by stating that economists tend to believe in interior solutions for most problem, and that there is nothing that prevents the government

from pursuing a managed float in which half of every fluctuation in demand for its currency is accommodated by intervention and half is allowed to be reflected in the exchange rate. Following this argument, the intermediate regime can be interpreted as an interior solution by giving up a bit of all three in the framework of the Impossible Trinity. As capital market integration increases, one of interior solutions forces countries to raise the flexibility of exchange rate, if monetary independence is kept. In the 1990s, emerging market economies promoted deregulation in their financial markets so that capital market integration deepened particularly in private sector. In this context, they should have made their exchange rates more flexible than the simple dollar pegging, even under the framework of intermediate exchange rate regime.⁵ We can, therefore, speculate that the currency crisis in the 1990s was caused by the inconsistent policy to stick to the dollar peg regime (inflexible exchange rate) under the capital market integration. We can further presume that the crisis-experienced countries, learning a lesson from the crisis, have raised the flexibility of exchange rate in the post-crisis period.

3. Empirical Studies on Crisis-experienced Countries

We here conducted empirical analyses of the exchange rate managements in the crisis-experienced emerging market economies after the 1990s. We focus, as sample countries, on the hardest-hit crisis countries: Mexico, Thailand, the Philippines, Indonesia, Korea, Russia and Brazil. We exclude Malaysia because she has formally adopted the US dollar peg system since 1998. In this section, we first review the previous studies analyzing directly the post-crisis exchange rate managements in emerging market economies. Second, before the empirical analyses, we clarify the using data and the period identification of the pre-crisis period and the post-crisis one. Third, we examine whether exchange rate flexibility has really increased from the pre-crisis period towards the post-crisis period under the framework of intermediate exchange rate regime in the sample countries. Fourth, we then analyze the factors to make exchange rate managements more flexible in the post-crisis period.

3.1. Previous Studies

In this section, we pick up some important studies on the post-crisis exchange rate management. First, McKinnon (2001) analyzed how the post-crisis exchange rate regime has evolved since 1998. According to his analyses, dollar exchange rates, particularly when observed on a high-frequency (daily) basis, have become as stable as they were before the crisis. Therefore, he stated that the East Asian dollar standard, except for Indonesia, seems to be resurrecting itself, and that the “fear of floating” identified by Calvo and Reinhart (2000) is shown at higher frequencies to be a rational response to capital market conditions in emerging markets. Second, Kawai (2002) also examined the evolution of exchange rate arrangements in East Asia’s emerging market economies over the last ten years. According to his analyses, in the post crisis period the dollar has regained prominence in some countries (notably in Malaysia), while its dominance has been reduced and exchange rate flexibility has risen in others (notably in Indonesia). Interesting is the observation that Korea and Thailand appear to have shifted to a de facto currency basket arrangement with significant weights on the US dollar and the yen, similar to Singapore’s managed floating arrangement.

To sum up, McKinnon (2002) argues that the post-crisis East Asian exchange rate managements are simply returning to the pre-crisis de fact dollar peg system, while Kawai (2002) insists that exchange rate flexibility has risen with the US dollar dominance reduced. The difference in the results might come from the difference in the post-crisis estimation periods; Kawai (2002) estimates from January 1999 to June 2002 as the post-crisis period, while McKinnon (2001) does from January 1999 to May 2000. In the estimate of Kawai (2002), the significant weight-shifts from the US dollar to the Japanese yen in Korea and Thailand are identified mainly after July 2000, which is beyond the estimate period of McKinnon (2001). Anyhow, we have to notify that both analyses focus on the highly -frequent (daily) exchange rate management.

3.2 Data and Period Identification

Before the following empirical analyses, we first clarify the using

data. We use the *monthly* data of exchange rates and related variables in the sample countries, taken from the International Financial Statistics of the International Monetary Fund. We analyze exchange rate movements on monthly base, because we are concerned with not daily exchange rate management but such middle-term management as considering inflation rate as a benchmark for determining a reference rate.

Second, we identify the pre-crisis period and the post-crisis one in each sample country. For this identification, we first review chronologies of exchange rate arrangements of sample countries after the 1990s. The chronologies of Table 1 are extracted from Reinhart and Rogoff (2002), which reclassified exchange rate regimes by employing newly compiled monthly data set on market-determined exchange rates. Mexico, who suffered from the currency crisis at the end of 1994, changed its exchange rate arrangement from de facto peg to US dollar through free floating towards managed floating. Thailand, the Philippines, Indonesia and Korea, who faced the crises in the latter half of 1997, altered their arrangement from de facto peg to US dollar towards managed or freely floating. Russia, who suffered from the crisis at the mid of 1998, changed its arrangement from dual market towards de facto crawling band around US dollar. Brazil, who faced the crisis at the beginning of 1999, altered its arrangement from crawling band around US dollar towards managed floating. From these chronologies, we find that all the sample countries but Russia has moved from US dollar standard arrangement in the pre-crisis period to more flexible arrangement in the post-crisis period.

Based on the above-mentioned chronologies, we divide the sample period from January 1990 to April 2003⁶ into the pre-crisis one and the post-crisis one by the crisis point, while excluding the turbulent crisis period (semi-annual term) with more than ten percent of monthly exchange rate fluctuation. Table 2 indicates the results of period partition. In Mexico, the pre-crisis period is from January 1990 to June 1994 and the post-crisis one is from January 1996 to April 2003. In Thailand, the pre-crisis one is from January 1990 to June 1997 and the post-crisis one is from July 1998 to April 2003. In the Philippines, Indonesia and Korea, the pre-crisis one is from January 1990 to June 1997 and the post-crisis one is from January 1999 to April 2003. In Russia, the period in which data is available in IFS (IMF 2003) is from July 1995 to January 2003. Therefore, the pre-crisis period is from July 1995 to June 1998 and the post-crisis one is from

January 1999 to January 2003. Brazil, who faced the crisis in the beginning of 1999, had experienced the drastic change in exchange rate arrangement in July 1994, when the Real Plan for stabilizing exchange rate had been adopted. Therefore, in Brazil, the pre-crisis period is from July 1994 to December 1998 and the post-crisis one is from July 1999 to April 2003.

3.3. Examining Exchange Rate Flexibility

Following the period partition above, we turn to the empirical examination on whether exchange rate flexibility has really increased from the pre-crisis period towards the post-crisis period under the framework of intermediate exchange rate regime in the sample countries.

For the purpose of analyzing exchange rate flexibility, we calculate the coefficients of variation of monthly exchange rates per US dollar in both the pre-crisis and the post-crisis period, and by comparing them, examine whether exchange rate flexibility has increased from the pre-crisis period towards the post-crisis period. Figure 1 simply shows the monthly movement of each exchange rate per US dollar during both the pre-crisis and the post-crisis period. Table 3 reports its coefficient of variation during both periods. We observe that: before the crisis, the local currency values per US dollar nearly level off or move stably, while after the crisis, they have shown monthly fluctuation; the coefficient of variation of all local currencies but Korea and Russia has clearly enlarged from the pre-crisis period to the post-crisis period. In Korea, the pre-crisis coefficient of variation appears to be larger than the post-crisis one. It seems to be because there had been so many changes in the pre-announced crawling band around US dollar during the pre-crisis period. In fact, the pre-crisis coefficient during the period (from January 1996 to July 1997) without any change in the crawling band is smaller than the post-crisis one. We can, therefore, speculate that Korea would have increased its exchange rate flexibility towards the post-crisis period without any change in the crawling band during the pre-crisis period. The Russian result of slightly decreasing coefficient of variation towards the post-crisis period, seems to be consistent with the chronology that its arrangement has been sifted from the pre-crisis dual market towards the

post-crisis de facto crawling band around US dollar. From this observation, we speculate that all the sample countries but Russia, who maintained the US dollar standard in their post-crisis exchange rate managements, have increased their exchange rate flexibility towards the post-crisis period.

The question then arises as to whether the rising exchange rate flexibility is only the reflection of the sample countries' adopting the "free float" or the effect of their changing exchange rate managements under the "soft peg" regime in the post-crisis period. In this article, we presume the latter case, since we follow the "Fear of Floating" hypothesis as we stated in Section 2.2. The previous studies of McKinnon (2001) and Kawai (2002) shown in Section 3.1 also argue the post-crisis exchange rate managements on the assumption that East Asia's emerging market economies have still kept the "soft peg" even in the post-crisis period.

According to the chronology extracted from Reinhart and Rogoff (2002) in Table 1 of Section 3.2, Indonesia and Korea among our sample countries have moved towards freely floating arrangement in the post-crisis period, while the other sample countries have moved towards managed floating one or de facto crawling band around US dollar. The post-crisis managements of Indonesia and Korea, however, seems to be not so different from those of the other sample countries. We here examine the post-crisis volatility of foreign exchange reserves among the sample countries, by calculating the coefficient of variation in the monthly foreign exchange reserves on the US Dollar base in the post-crisis period. If a country adopts the regime of "pure float", the coefficient of variation should, in principle, be zero. Table 4 indicates the coefficient of variation in the foreign exchange reserves as well as the exchange rate regime based on the classification by Reinhart and Rogoff (2002) during the post-crisis period. We observe that the coefficient of variation of Indonesia with freely floating is almost the same as that of the Philippines with managed floating, and that the coefficient of variation of Korea with freely floating even exceeds those of the Philippines, Thailand and Brazil with managed floating. We therefore speculate that even Indonesia and Korea have adopted not purely free floating but managed floating as the other sample countries have.

3.4. Identifying the Factors for Raising Exchange Rate Flexibility

The next step is to identify the factors to make exchange rate managements more flexible in the post-crisis period. As the previous section shows, all the sample countries appear to adopt “soft peg” regime even in the post-crisis exchange rate managements. In this context, the rising flexibility of exchange rate means that the benchmarks for the choice of reference rates in the managed exchange rates may be diversified in the post-crisis period compared with the single benchmark of the US dollar in the pre-crisis period. To verify this point, we conduct regression analysis to identify the factors for determining reference rates in managing exchange rates. We first show a regression model for analysis. We then clarify a method for analyzing structural change of exchange rate managements. We lastly present the results and their interpretations.

Regression model

The previous studies of McKinnon (2001) and Kawai (2002) in Section 3.1 use the analytical framework of Frankel and Wei (1994) in their analyses, on the assumption that East Asia's emerging market economies have adopted the “soft peg” in the pre-crisis and post-crisis period. Since we speculate that all the sample countries have adopted “soft peg” regime, we basically follow the work of Frankel and Wei (1994), but modify it in accordance with our analytical concern. Our specific concern on exchange rate management is whether the sample countries, not simply relying on the US dollar, have cared more about such other factors as currency basket including the Japanese yen or the euro and inflation rate as the benchmarks for the choice of reference rates during the post-crisis period. Unlike Frankel and Wei (1994), we take inflation term into account as a benchmark for a reference rate. It is because the strategy for the “soft peg” often involves a crawling peg or target in which one country's currency is allowed to depreciate at a steady rate against that of another country so that its inflation rate can be higher than that of the country to which it is pegged. As mentioned in Section 2.1, Williamson (2000) recommends the BBC rules for emerging market economies. It states that the crawl, one of the elements of the BBC, is often used with a view to neutralizing differential inflation. Ohno (1999) also comes up with the pragmatic rules in post-crisis exchange rate

management, which include the rule to stabilize real effective exchange rate through a multiple currency basket with inflation slide. We thus focus on not daily but such middle-term management as considering inflation rate, and specify the regression model in the following way.

$$\Delta \log(\text{Local Currency}/\text{SWF}) = \alpha_1 \Delta \log(\text{USD}/\text{SWF}) + \alpha_2 \Delta \log(\text{JPY}/\text{SWF}) \\ + \alpha_3 \Delta \log(\text{DEM}(\text{EURO})/\text{SWF}) + \alpha_4 \Delta \log(\text{WPI3D}) + \varepsilon$$

Where SWF is the Swiss franc, USD is the US dollar, JPY is the Japanese yen, DEM is the German mark and ε is assumed to be a well-behaved error term, following $N(0, \sigma^2)$. EURO (the euro currency) is used after the time of its advent, January 1999, instead of DEM. The Swiss franc is chosen as an arbitrary *numéraire* for measuring variations in the exchange rate, because it is an independently floating currency of an advanced country, which nonetheless carries little weight in the sample countries' trade. WPI3D is the three-month moving average of the differential of the wholesale price index (WPI) of the local country from that of the *numéraire* country, Switzerland. We use the three-month moving average of the index because we take the causality relationship from WPI to the value of local currency into account. WPI is considered to be an appropriate price index because it has a greater weight on tradable goods than the consumer price index has, thereby reflecting directly price competitiveness. The price differential stands for the relative level of domestic prices to foreign countries' prices (we here use the index of *numéraire* country, Switzerland), which can be one of the targets of crawling pegging. Based on the first difference of logarithms (percentage changes), the simple regression model is multivariate ordinary least squares for each country. The using data and estimating periods are the ones that were identified in Section 3.2.

According to Frankel and Wei (1994), if the local currency is tightly fixed to some particular value of the US dollar, then the regression coefficient α_1 should be discernable and approximately unity, while the others, α_2 and α_3 , are close to 0. Another crucial variable is the WPI3D. If its coefficient, α_4 , is significantly positive, we assume that the relative inflation rate can be one of the factors for determining a reference rate in managing exchange rate.

Before the regression, we test the stationarity of all the data series

by using the unit root tests of the Augmented Dickey-Fuller (ADF) test and the Philips-Perron (PP) test (for the test methodology, see Matsuura and McKenzie 2001). Appendix 1 reports that at the one percent significance level, all the first-differenced data series are confirmed as stationary in either test, thereby suggesting that a regression analysis using all the first-differenced data series is valid. Appendix 2 presents the results of the regressions during all the estimated periods.

Analytical Method: Chow's Test and Dummy for Parameter

We here take two steps in our analysis. First, we conduct Chow's breakpoint test to examine whether there was a structural change in the factors for determining a reference rate in managing exchange rate from the pre-crisis period to the post-crisis period. The data are broken up into the pre-crisis period and the post-crisis one that Section 3.2 identified in each sample country. By showing the F-statistics with probabilities for the hypothesis of parameter stability over different periods, we confirm a structural change from the pre-crisis period towards the post-crisis period in each sample currency.

Second, we then identify the factors to cause the structural change by examining whether each parameter in regression model has been significantly changed from the pre-crisis period to the post-crisis period. For verifying the parameter change, we modify the regression model as follows.

$$\begin{aligned} \Delta \log(\text{Local Currency}/\text{SWF}) = & (\alpha_1 + \alpha'_1 D) \Delta \log(\text{USD}/\text{SWF}) \\ & + (\alpha_2 + \alpha'_2 D) \Delta \log(\text{JPY}/\text{SWF}) + (\alpha_3 + \alpha'_3 D) \Delta \log(\text{DEM}(\text{EURO})/\text{SWF}) \\ & + (\alpha_4 + \alpha'_4 D) \Delta \log(\text{WPI3D}) + \varepsilon \end{aligned}$$

where D is the post-crisis dummy. In this modified regression, if some coefficients α' are significant, they are the causes of a structural change in the post-crisis period. We can then identify the changes in factors for determining a reference rate in exchange rate management from the pre-crisis period towards the post-crisis one.

Results and Interpretations

Table 5 and Table 6 report the results of Chow's test and the modified regressions. The main observations and their interpretations are

as follows.

The results of Chow's breakpoint test indicate that the hypothesis of parameter stability over the pre- and post-crisis periods is rejected on all the local currencies: Mexican new peso, Thai baht, Indonesian rupiah and Korean won at the one percent significance level and Philippine peso, Russian ruble and Brazilian real at the ten percent level. In Russian ruble, though its post-crisis flexibility increase was not identified in Section 3.3, the post-crisis structural change in its exchange rate management was identified. The post-crisis structural change in exchange rate management is, therefore, verified on all the sample currencies through the Chow's breakpoint test.

The results of the modified regression on all the sample local currencies in which a structural change was identified above are as follows. First, looking at the coefficients of US dollar, the ones in the whole period are significantly positive and an approximately unity on all the local currencies. The ones with the post-crisis dummy are negative on Thai baht, Philippine peso, Indonesian rupiah, Korean won and Russian ruble – significantly negative on Thai baht, Philippine peso and Korean won, while positive on Mexican new peso and Brazilian real – significantly positive on Mexican new peso. Therefore, all the sample countries seem to be holding the "soft peg" to US dollar during not only the pre-crisis period but also the post-crisis period regardless of its assigned weights. During the post-crisis period, Thailand, the Philippines and Korea among East Asian countries appear to reduce the weight assigned to US dollar as a factor for determining a reference rate. On the contrary, Mexico seems to raise the US dollar weight in the post-crisis exchange rate management.

Second, some of the coefficients of Japanese yen and the coefficients of euro (or German mark) indicate significant increases towards the post-crisis period. The coefficients of Japanese yen in the whole period are significantly positive on Thai baht and Korean won. The ones with the post-crisis dummy are significantly positive on Philippine peso and Korean won. This means that the Philippines and Korea may raise the weights assigned to Japanese yen towards the post-crisis period. The coefficients of euro (or German mark) with the post-crisis dummy are significantly positive on Thai baht and Indonesian rupiah, thereby showing that Thailand and Indonesia may increase the weights assigned to euro

(or German mark) towards the post-crisis period.

Third, concerning with the coefficients of the WPI3D, the one in the whole period is significantly positive on Mexican new peso, Philippine peso and Korean won, while the ones with the post-crisis dummy are significantly positive on Thai baht, Indonesian rupiah, Russian ruble and Brazilian real. We can speculate, therefore, that the countries whose exchange rate managements were not sensitive to inflation rates during the pre-crisis period – Thailand, Indonesia, Russia and Brazil, may have come to take inflation rates into account as one of the factors for determining a reference rate towards the post- crisis period.

To sum up, the Chow's breakpoint test could identify a structural change in exchange rate management from the pre-crisis period to the post-crisis period in all the sample countries. The modified regression analysis showed that the East Asian sample countries (except Indonesia) might reduce the US dollar dominance while they might raise the other currencies' weight (of Japanese yen or euro), in their post-crisis exchange rate managements. The analysis further indicated that those sample countries who did not show any sensitivity to inflation rates in their pre-crisis managements, could raise its sensitivity in the post-crisis managements.

The backgrounds where the East Asian countries among the sample countries have shifted the weights from the US dollar to Japanese yen or euro in their post-crisis exchange rate managements seem to consist in their trade structure. Table 7 stands for the percentage distribution on the directions of trade of the sample countries. We found that the East Asian countries – Thailand, the Philippines, Indonesia and Korea, have the percentage distribution from ten percent to twenty percent in the trades with the US, EU and Japan respectively, while Mexico, Russia and Brazil have the higher distribution in the trades with the US and/or EU. In this sense, it can be said that the East Asian countries have the well-balanced weights of trade direction among the US, EU, and Japan as trade partners, compared with the other sample countries. It seems, therefore, to be quite reasonable that the East Asian countries with the well-balanced trade directions may move from the single currency regime of the US dollar peg towards the basket currency regime.

We here compare the result of the above estimation with that of

Kawai (2002). Kawai (2002) showed that Korea and Thailand had significantly shifted the weight from the US dollar to the Japanese yen in their post-crisis managed floating arrangement. Our estimation identified such a weight-shift in Korea but not in Thailand. We speculate that the difference in the result might mainly come from the difference in the frequency in exchange rate management to be analyzed; Kawai (2002) conducts a Frankel-Wei type of regression on a *daily* base for examining the highly- frequent exchange rate management (the original analysis by Frankel and Wei (1994) is on a weekly base). On the other hand, our analysis concentrates on the *monthly* exchange rate management, considering inflation rate as a benchmark for determining a reference rate. The further contribution of our estimation, which is different from that of Kawai (2002), is that we examined and verified sensitivity to inflation rates as one of the factors for determining a reference rate in the *monthly* exchange rate management.

4. Concluding Remarks

In this article, we set out to examine, conducting empirical studies, the exchange rate managements in the crisis-experienced emerging market economies after the 1990s. We focused, as analytical sample countries, on the seven crisis-experienced countries among emerging market economies: Mexico, Thailand, the Philippines, Indonesia, Korea, Russia and Brazil. In analyzing the post-crisis exchange rate managements, the focus of questions was on whether, after the crisis, the crisis-experienced countries are simply returning to the pre-crisis dollar peg regime, or whether they have learned a lesson from the crisis and are finding another path to follow. Our hypothesis was that the crisis-experienced countries did really learn a lesson that the currency crisis in the 1990s was partly caused by their sticky dollar peg regimes under the capital market integration, and might have raised the flexibility of exchange rate managements in the post-crisis period. Under the framework of the "soft peg" exchange rate regime, the rising flexibility of exchange rate means that the benchmarks for the choice of reference rates in the managed exchange rates may be diversified in the post-crisis period compared with the single benchmark of the US dollar in the pre-crisis period. Thus, our analytical, specific concern on the flexibility of

exchange rate was whether the crisis-experienced countries, not simply relying on the US dollar pegging, had cared more about such other factors as inflation rates and currency basket including Japanese yen and euro as the benchmarks for the choice of reference rates in their exchange rate managements during the post-crisis period.

Section 3, based on the fore-mentioned analytical concern, conducted empirical analyses on the sample countries by the following two steps: first, to examine exchange rate flexibility under the "soft peg" regime by calculating the coefficient of variation in the monthly nominal exchange rates during the pre-crisis and the post-crisis periods, and foreign exchange reserves in the post-crisis periods; second, to identify the factors to make exchange rate movements more flexible in the post-crisis period by conducting regression analysis with Chow's breakpoint test based on the analytical framework of Frankel and Wei (1994).

The main findings from the analyses above are as follows: First, the trends of the coefficient of variation in the monthly nominal exchange rates revealed that the exchange rate flexibility of all the sample countries but Russia had increased from the pre-crisis period towards the post-crisis period. At the same time, the coefficient of variation in the post-crisis monthly foreign exchange reserves told us that all the sample countries including Indonesia and Korea might have been still holding to the "soft peg" regime even in the post-crisis period. This justified the Frankel-Wei type of regression analysis for identifying the changes in the factors for determining a reference rate in exchange rate management from the pre-crisis period to the post-crisis period. Second, the Chow's breakpoint test could identify a structural change in the factors for determining a reference rate in exchange rate management from the pre-crisis period to the post-crisis period in all the sample countries. Third, the regression analysis showed that the East Asian sample countries (except Indonesia) might reduce the US dollar dominance while they might raise the other currencies' weight (of Japanese yen or euro), in their post-crisis exchange rate managements. The backgrounds where the East Asian countries have shifted the weights from the US dollar to Japanese yen or euro seem to consist in their well-balanced weights of trade direction towards the US, EU, and Japan. The regression analysis further indicated that those sample countries who did not show any

sensitivity to inflation rates in their pre-crisis managements, could raise its sensitivity in the post-crisis managements.

The following issues still need analysis: First, the post-crisis period after the 1990s is a little too short to provide sufficient monthly data. We will, therefore, need the re-analyses to get more consolidated outcomes by keeping track of the upcoming data. Second, it may be useful for our analysis to extend to non-crisis countries and to develop through a comparative study between hardest-hit crisis countries and non-crisis countries.

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Table 1 Chronologies for Exchange Rate Arrangements in the 1990s

Mexico

Date	Classification: Primary/Secondary/Tertiary	Comments
December 1988 – November 11, 1991	Crawling peg/ Dual Market	
November 11, 1991 – April 1992	De facto crawling peg to US Dollar	The rates were unified in November 1991. The official arrangement was an ever widening crawling band.
May 1992 – January 1994	De facto peg to US Dollar	Officially there is a band. The annualized rate of crawl of the upper limit of the band is 2.4% through October 20, 1992 and 4.7% through June
February 1994 – December 22, 1994	Pre announced crawling band around US Dollar	Pre-announced band becomes binding.
December 22, 1994 – March 1996	Freely falling/ Freely floating	In December 1994 the parallel market premia jumped to 27% from single digits.
April 1996 – December 2001	Managed floating	

Thailand

Date	Classification: Primary/Secondary/Tertiary	Comments
March 8, 1978 – July 1997	De facto peg to US Dollar	The Baht is officially pegged to a basket of currencies.
July 1997 – January 1998	Freely falling/ Freely floating	
January 1998 – December 2001	Managed floating	

Philippines

Date	Classification: Primary/Secondary/Tertiary	Comments
March 1985 – April 1992	De facto crawling peg to US Dollar	
May 1992 – April 1993	De facto band around US Dollar	Band width is +/-2%.
May 1993 – August 1995	De facto band around US Dollar	Band width is +/-5%.
September 1995 – June 1997	De facto peg to US Dollar	
July 1997 – December 1997	Freely falling/ Freely floating	Parallel market premia peaked at 17% on July
December 1997 – December 2001	Managed floating	

Indonesia

Date	Classification: Primary/Secondary/Tertiary	Comments
November 16, 1978 – July 1997	De facto crawling peg to US Dollar	Officially pegged to a basket of undisclosed currencies. Premium consistently below 20% and mostly in single digits.
August 1997 – March 1999	Freely falling/ Freely floating	A dual rate comes into effect briefly in February 1998, when a subsidized rate was applied to certain food imports.
April 1999 – December 2001	Freely floating	

Korea

Date	Classification: Primary/Secondary/Tertiary	Comments
March 2, 1990 – September 2, 1991	Pre announced crawling band around US Dollar	Band width +/-0.4%.
September 2 1991 – July 1, 1992	Pre announced crawling band around US Dollar	Band width +/-0.6%.
July 1, 1992 – October 1, 1993	Pre announced crawling band around US Dollar	Band width +/-0.8%.
October 1, 1993 – November 1, 1994	Pre announced crawling band around US Dollar	Band width +/-0.1%.
November 1, 1994 – December 1, 1995	Pre announced crawling band around US Dollar	Pre announced band is +/-1.5%.
December 1, 1995 – November 1997	De facto crawling peg to US Dollar	Officially the pre announced band is +/-2.25%.
December 17, 1997 – June 1998	Freely falling	The Won was allowed to float.
July 1998 – December 2001	Freely floating	

Russia

Date	Classification: Primary/Secondary/Tertiary	Comments
January 1992 – June 1, 1995	Freely falling/ Market	There is no price data before this date.
July 6, 1995 – July 1996	Freely falling/ Market	Pre announced crawling band around US Dollar for the official rate
August 1996 – August 17, 1998	Dual Market	Pre announced crawling band around US Dollar for the official rate
August 17, 1998 – November 1999	Free falling/ Dual Market	The band was widened on August 17 and eliminated on September 2. On June 29, 1999 the two rates are unified temporarily.
December 1999 – December 2001	De facto crawling band around US Dollar	Band width +/-2%. There are multiple rates.

Brazil

Date	Classification: Primary/Secondary/Tertiary	Comments
April 1989 – July 1, 1994	Freely falling/ Freely floating/ Multiple rates	On December 1989 the parallel market premium rises to 23.5%. December 1989 – March 1990 regime is a "hyperfloat."
July 1, 1994 – May 1995	Pre-announced crawling band to US Dollar/ Freely falling/ Dual Market	The Real Plan has a narrow band width. The Real replaces the Cruzado. There is a dual market but parallel premium during this period is trivial.
June 1995 – January 18, 1999	Pre-announced crawling band to US Dollar/ Dual Market	
February 1, 1999 – August 1999	Freely falling/ Managed floating	On January 18, 1999 the two rates were unified.
September 1999 – December 2001	Managed floating	

Source: Reinhart and Rogoff (2002)

Table 2 Pre- and Post- Crisis Periods in Each Country

Country	Currency	Pre-crisis Period	Post-crisis Period
Mexico	Mexican new peso	January 1990 – June 1994	January 1996 – April 2003
Thailand	Thai baht	January 1990 – June 1997	July 1998 – April 2003
Philippines	Philippine peso	January 1990 – June 1997	January 1999 – April 2003
Indonesia	Indonesian rupiah	January 1990 – June 1997	January 1999 – April 2003
Korea	Korean won	January 1990 – June 1997	January 1999 – April 2003
Russia	Russian ruble	July 1995 – June 1998	January 1999 – January 2003
Brazil	Brazilian real	July 1994 – December 1998	July 1999 – April 2003

Table 3 Coefficient of Variation in Currency Values per US Dollar

Country	Currency	Pre-crisis Period	Post-crisis Period
Mexico	Mexican new peso	0.050	0.102
Thailand	Thai baht	0.012	0.070
Philippines	Philippine peso	0.054	0.121
Indonesia	Indonesian rupiah	0.083	0.124
Korea	Korean won	0.058 (0.051) ¹⁾	0.055
Russia	Russian ruble	0.106	0.091
Brazil	Brazilian real	0.103	0.256

Notes:

1) The coefficient of variation with a parenthesis is the one during the period from January 1996 to July 1997, in which there was no change in the pre-announced crawling band around US Dollar.

Source: IFS (IMF 2002)

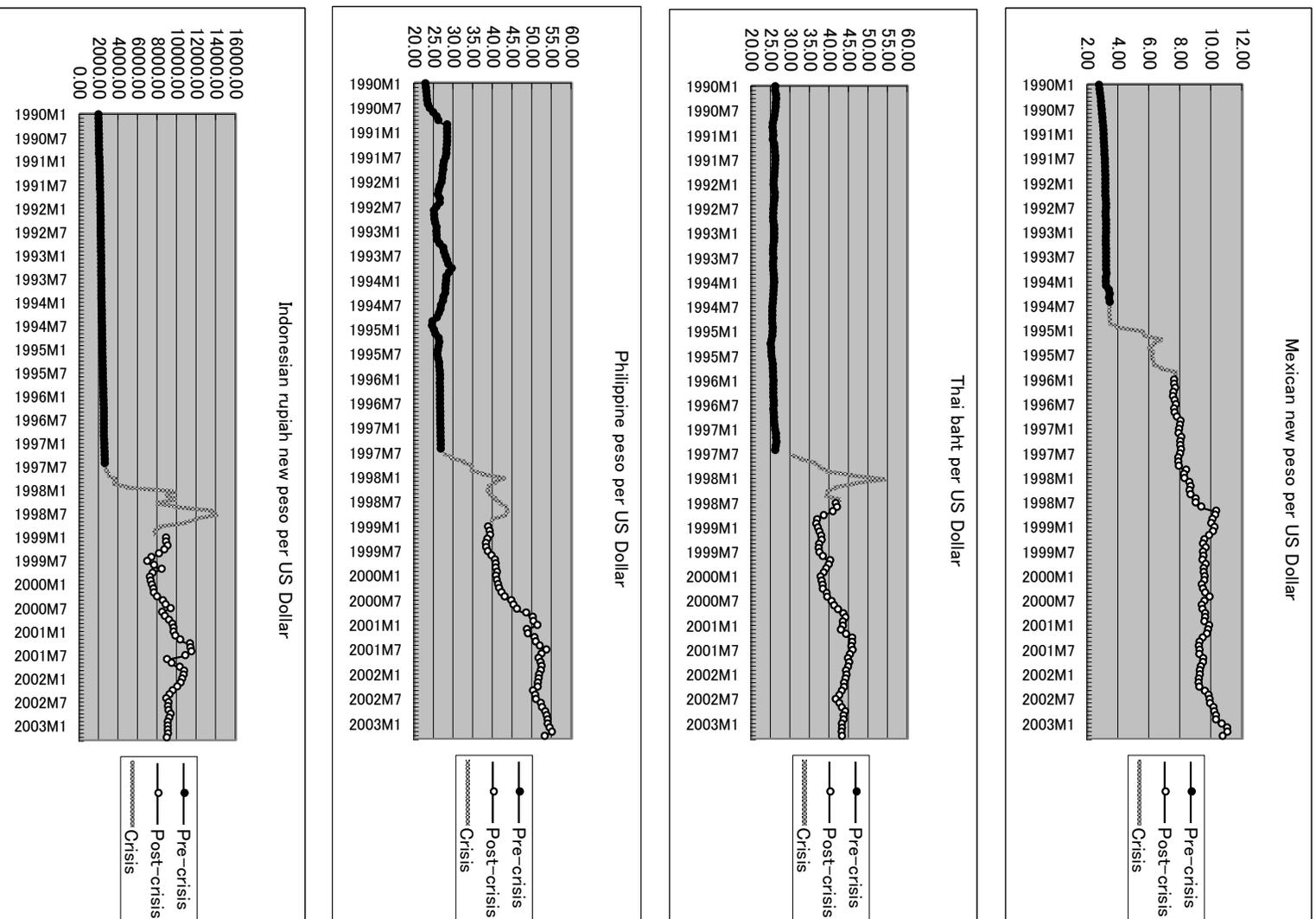
Table 4 Coefficient of Variation in Foreign Exchange Reserves during Post-crisis Period

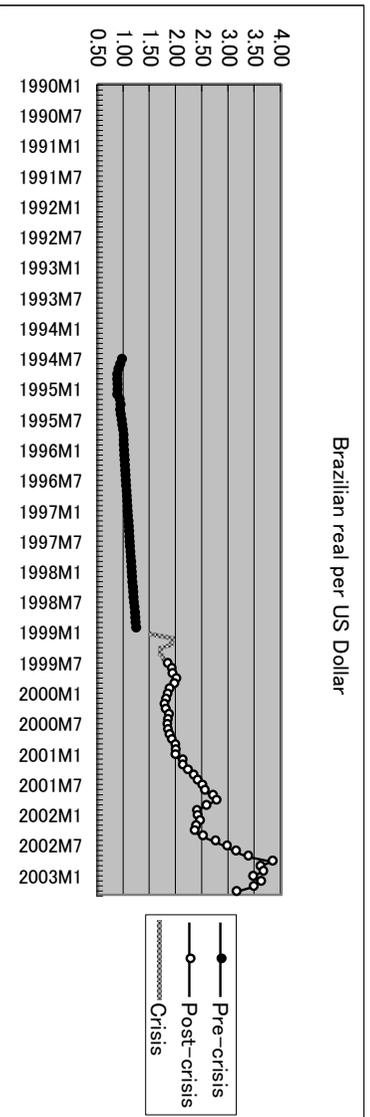
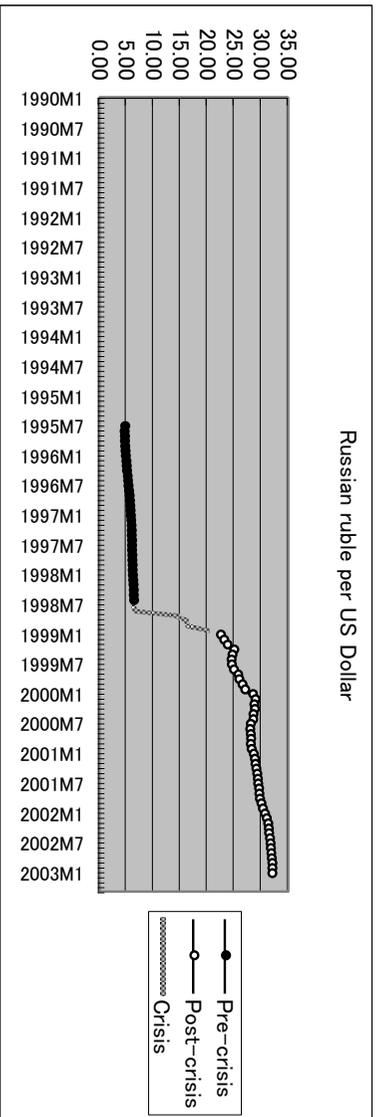
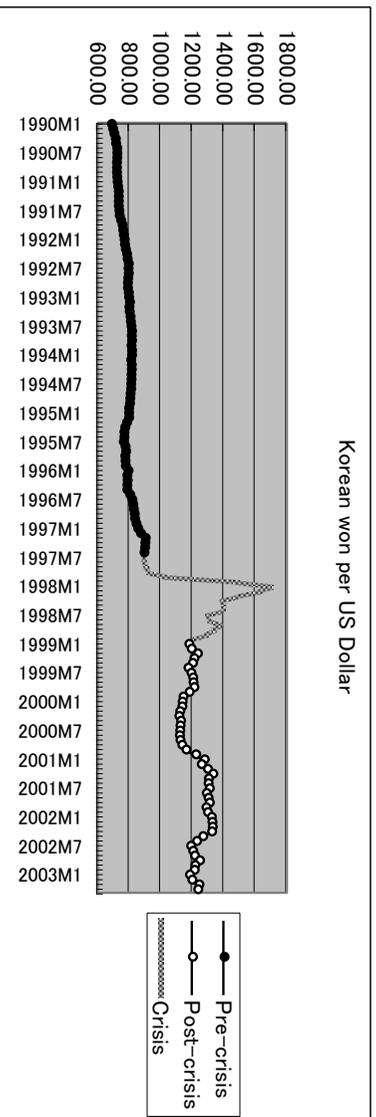
Country	Currency	C. V.	Exchange Rate Regime
Mexico	Mexican new peso	0.298	Managed floating
Thailand	Thai baht	0.093	Managed floating
Philippines	Philippine peso	0.069	Managed floating
Indonesia	Indonesian rupiah	0.065	Freely floating
Korea	Korean won	0.219	Freely floating
Russia	Russian ruble	0.558	De facto crawling band
Brazil	Brazilian real	0.108	Managed floating

Notes:

Source: IFS (IMF 2002), Reinhart and Rogoff (2002)

Figure 1 Trends of Exchange Rates during Pre- and Post- Crisis Period





Source: IFS (IMF)

Table 5. Results of Chow's Breakpoint Test on Regression for Currency Values

	F-statistic	Probability	Breakpoint
Mexican new peso	5.446	0.000	January 1996
Thai baht	5.718	0.000	July 1998
Philippine peso	2.087	0.086	January 1999
Indonesian rupiah	6.363	0.000	January 1999
Korean won	8.276	0.000	January 1999
Russian ruble	2.101	0.089	January 1999
Brazilian real	2.312	0.064	July 1999

Notes:

1) All currencies are in terms of units of Swiss francs.

Source: IFS (IMF 2002)

Table 6. The Results of Regressions for Currency Values including Post-crisis Dummy

	USD	JPY	DEM/EURO	WPI3D	R**2	D.W.
Mexican new peso	1.04 ***	-0.04	-0.03	0.36 *	0.84	1.88
Dummy	0.36 ***	0.08	0.12	0.15		
Thai baht	0.82 ***	0.11 **	0.07	0.01	0.86	1.23
Dummy	-0.22 ***	0.10	0.61 **	1.18 ***		
Philippine peso	1.10 ***	-0.11	0.12	0.32 **	0.76	1.48
Dummy	-0.30 **	0.25 **	0.55	0.65		
Indonesian rupiah	0.95 ***	0.02	0.06	0.38	0.56	1.73
Dummy	-0.04	-0.42 *	1.85 **	1.98 ***		
Korean won	0.87 ***	0.09 **	0.01	0.76 **	0.87	1.16
Dummy	-0.29 ***	0.46 ***	0.14	-0.16		
Russian ruble	0.96 ***	-0.07	0.06	0.09	0.73	0.97
Dummy	-0.04	0.13	-0.53	0.30 **		
Brazilian real	1.05 ***	-0.01	0.15	-0.17	0.49	1.49
Dummy	0.12	-0.07	0.18	1.08 ***		

Notes:

1) All currencies are in terms of units of Swiss francs.

2) The estimation period is both the pre-crisis one and the post-crisis one.

3) "Dummy" is for the post-crisis period.

4) *, **, *** indicate that the coefficient is significant at the 90, 95, and 99 percent levels, respectively.

Source: IFS (IMF 2002)

Table 7. Percent Distribution on Direction of Trade (%)

	Mexico	Thailand	Philippines	Indonesia	Korea	Russia	Brazil
U.S.A.	75.8	14.8	21.7	12.2	17.8	5.4	24.1
EU	6.6	13.0	12.4	14.1	12.3	32.1	26.2
Japan	3.0	18.7	17.0	19.7	14.3	1.6	4.1

Notes:

- 1) Trade in this table shows the sum of exports and imports in the US dollar term.
 - 2) Column indicates each sample country's trade share with partners of the U.S.A, EU, and Japan.
- Sources: Direction of Trade Statistics Yearbook 2003, IMF.

Appendix 1 Unit Root Tests on Data for Regression

Variables	ADF Statistic		PP Statistic	
	Intercept	Trend and Intercept	Intercept	Trend and Intercept
$\Delta \log(\text{Mexican new peso}/\text{SWF})$	-7.59 ***	-7.56 ***	-8.43 ***	-8.40 ***
$\Delta \log(\text{Thai baht}/\text{SWF})$	-8.23 ***	-8.20 ***	-6.32 ***	-6.31 ***
$\Delta \log(\text{Philippine peso}/\text{SWF})$	-7.32 ***	-7.29 ***	-8.11 ***	-8.08 ***
$\Delta \log(\text{Indonesian Rupiah}/\text{SWF})$	-9.15 ***	-9.13 ***	-9.24 ***	-9.21 ***
$\Delta \log(\text{Korean won}/\text{SWF})$	-7.74 ***	-7.73 ***	-8.75 ***	-8.72 ***
$\Delta \log(\text{Russian ruble}/\text{SWF})$	-7.38 ***	-7.37 ***	-7.84 ***	-7.87 ***
$\Delta \log(\text{Brazilian real}/\text{SWF})$	-5.11 ***	-5.07 ***	-6.13 ***	-6.11 ***
$\Delta \log(\text{USD}/\text{SWF})$	-8.13 ***	-8.11 ***	-9.00 ***	-8.97 ***
$\Delta \log(\text{JPY}/\text{SWF})$	-8.25 ***	-8.33 ***	-9.48 ***	-9.49 ***
$\Delta \log(\text{DEM(EURO)}/\text{SWF})$	-7.61 ***	-7.58 ***	-9.91 ***	-9.88 ***
$\Delta \log(\text{WPI3D Mexico}/\text{SWF})$	-4.50 ***	-4.74 ***	-4.05 ***	-4.10 ***
$\Delta \log(\text{WPI3D Thailand}/\text{SWF})$	-6.29 ***	-6.28 ***	-3.71 ***	-4.68 ***
$\Delta \log(\text{WPI3D Philippines}/\text{SWF})$	-5.58 ***	-5.71 ***	-5.57 ***	-5.67 ***
$\Delta \log(\text{WPI3D Indonesia}/\text{SWF})$	-8.48 ***	-8.44 ***	-3.98 ***	-3.96 ***
$\Delta \log(\text{WPI3D Korea}/\text{SWF})$	-6.52 ***	-6.45 ***	-4.83 ***	-4.79 ***
$\Delta \log(\text{WPI3D Russia}/\text{SWF})$	-3.56 ***	-3.42 *	-3.45 **	-3.18 *
$\Delta \log(\text{WPI3D Brazil}/\text{SWF})$	-3.08 **	-3.32 *	-6.39 ***	-7.11 ***

Notes:

- 1) The lag truncation is one quarter in the ADF test, and three quarters in the PP test.
- 2) ***, **, and * indicate rejection of the null of nonstationarity at the 1 percent, 5 percent, and 10 percent significance levels with critical values taken from Davidson and MacKinnon (1993).

Source: IFS(IMF)

Appendix 2 Results of Regressions in All the Estimated Periods

	USD	JPY	DEM/EURO	WPI3D	R**2	D.W.
Mexican new peso	1.23 ***	-0.00	-0.05	0.43 ***	0.82	1.83
Thai baht	0.72 ***	0.14 ***	0.25 **	0.40 **	0.84	1.15
Philippine peso	1.01 ***	-0.04	0.26	0.40 ***	0.75	1.41
Indonesian rupiah	0.80 ***	-0.04	0.58 *	1.50 ***	0.49	1.73
Korean won	0.80 ***	0.24 ***	-0.01	0.77 ***	0.84	1.34
Russian ruble	0.99 ***	-0.04	-0.15	0.25 ***	0.72	0.88
Brazilian real	1.13 ***	-0.06	0.17	0.52 ***	0.46	1.34

Notes:

- 1) All currencies are in terms of units of Swiss francs.
- 2) *, **, *** indicate that the coefficient is significant at the 90, 95, and 99 percent levels, respectively.

Source: IFS (IMF 2002)

Notes

1. As the latest study, Fischer (2001) discusses the corner solution hypothesis.
2. In addition to the fore-mentioned arguments, some studies simply support floating exchange rate regimes. For example, Mussa et al. (2000) argued that floating regimes appear to have been helpful in handling a variety of economic shocks for many emerging market countries, by stating that the policy requirements for maintaining a pegged exchange rate can be very demanding in circumstances of high international capital mobility as seen in the tequila crisis of 1995 and the Asian/Russian/Brazilian crises of 1997-98. Eichengreen (1999) also stated that the IMF should more forcefully press for the adoption of more flexible exchange rates by most of its developing country members, especially by those with open capital accounts.
3. Masson (2000) also made a careful statistical examination of the way in which countries have changed their exchange rate regime over the years. He found that, although there has been some tendency for countries to polarize toward the extremes, it is far weaker than one would infer from the sort of summary of Latin American experience.
4. French and Japanese staff (2002) also argued that a possible solution for many emerging market economies could be a managed floating exchange rate regime whereby the currency moves within a given band with its center targeted to a basket of currencies including the dollar, the yen and the euro.
5. As for the analyses of the negative impacts of the dollar peg system on the external balances in the selected East Asian countries, see Taguchi (2003a) and Taguchi (2003b).
6. April 2003 is the latest point in data availability in IFS (IMF 2003).